(12) UK Patent Application (19) GB (11) 2 256 910 (13) A

(43) Date of A publication 23.12.1992

(21) Application No 9211024.6

(22) Date of filing 22.05.1992

(30) Priority data
(31) 9101589 (32) 24.05.1991 (33) SE

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(51) INT CL[5]
F16L 9/18, B21D 26/08 39/04

(52) UK CL (Edition K)
F2P PC20 P1B5A
B3Q Q1R3
U1S S1573 S1573 S1675 S1676

(56) Documents cited
GB 2173275 A

(58) Field of search
UK CL (Edition K) B3Q, F2P PC20 PM1 PR PTBL
INT CL[5] B21D 26/08

(54) Mechanically joining an inner tube to an outer tube

(57) A method of joining mechanically an inner tube (2) to an outer tube (1) by radial expansion of at least the inner tube with the aid of an internal overpressure.

The method is particularly characterized by filling the inner tube (2) with an explosive gas of determined composition, temperature and pressure, and by igniting and exploding the gas.

A core (14, Fig. 2, not shown) may be used to reduce the amount of gas required.

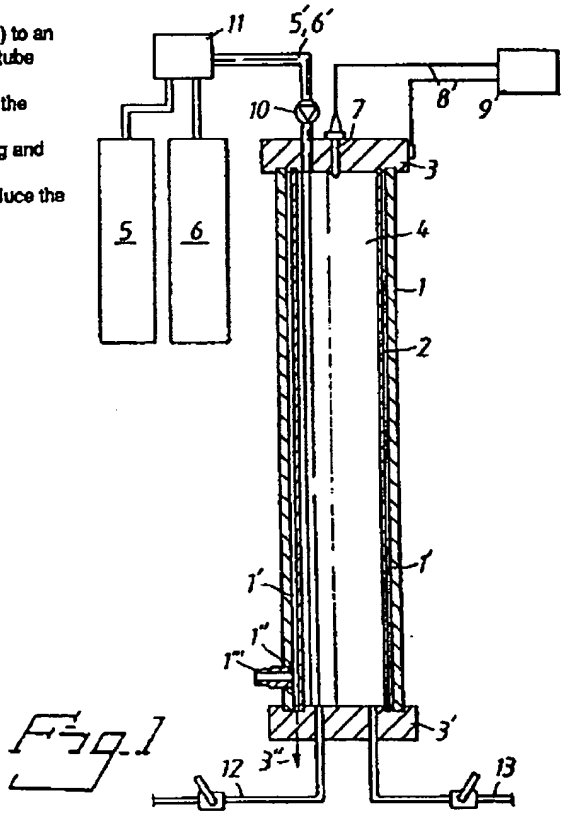

Fig.1

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Fig. 1

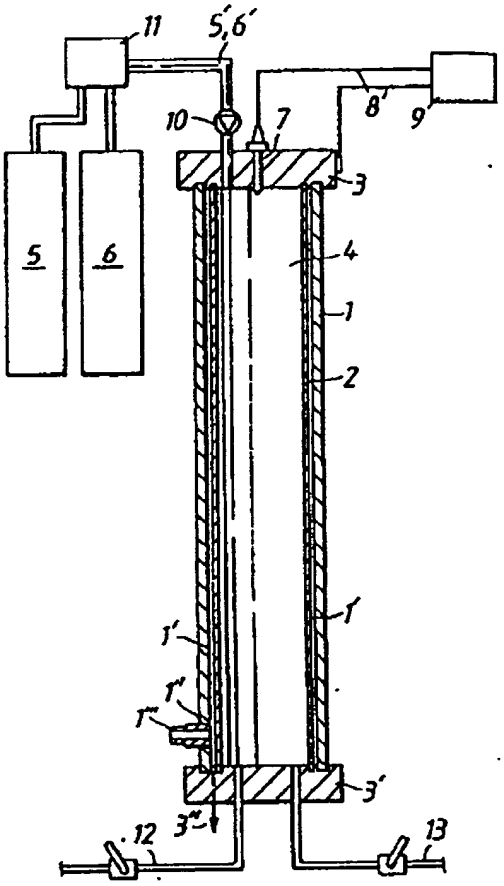
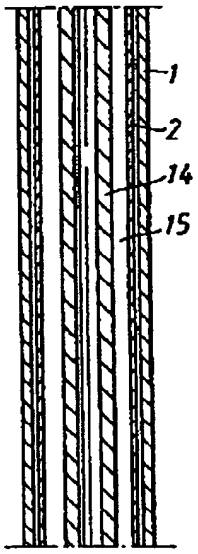


Fig. 2



A Method and Arrangement for Mechanically Joining an Inner Tube to an Outer Tube

The present invention relates to a method for joining an inner tube mechanically to an outer tube by radial expansion of at least the inner tube by means of an internal overpressure.

The invention also relates to an arrangement for carrying out the method.

It is often desirable in the oil industry, the chemical industry and in nuclear power plants, etc. to provide steel tubing or piping with an internal non-corroding ling made for instance of stainless steel, Inconel, Incolloy or titanium.

For some usages, it is necessary to bond the lining to the outer tube atomically, which can be achieved with the aid of explosion welding, extrusion or surface welding techniques.

Other usages, however, require solely a mechanical press joint, which can be achieved by pressing an inner tube of non-corroding material radially outwards and into contact with the outer tube, with the aid of an internal liquid pressure. Alternatively, the outer tube can be heated during the pressing operation, so that the joint will be strengthened by shrinkage as the outer tube cools.

In order to achieve a good join between the tubes, or pipes, the material of the inner tube should be deformed above its elastic limit and the outer tube material deformed within the limits of its elastic limit.

Although the known methods of creating a mechanical join are less expensive than the methods for achieving an atomic bond, they are nevertheless complicated and cost demanding due to the large dimensions and lengths of the tubing or piping concerned. For example, a 36" oil pipe of 12 metres in length will accommodate about 7.5 cubic metres of pressure medium.

Irrespective of whether radial expansion is effected with the aid of a hydraulic pump or with the aid an explosive charge in water, the cycle

period is quite considerable and handling is relatively difficult due to the amount of liquid used.

The present invention provides a quicker and a simpler method of effecting a mechanical join or connection between an inner non-corroding liner or tube and an outer tube.

The present invention thus relates to a method of joining mechanically an inner tube to an outer tube by radial expansion of at least the inner tube with the aid of an internal overpressure.

The method is particularly characterized in that the inner tube is filled with an explosive gas of determined composition, temperature and pressure, and in that the gas is caused to be ignited and exploded.

The invention also relates to an arrangement for joining mechanically an inner tube to an outer tube by radial expansion of at least the inner tube by means of an internal overpressure.

The arrangement is particularly characterized by devices for filling the inner tube with an explosive gas of determined composition, temperature and pressure; and by devices for igniting the explosive gas and causing the same to explode.

The invention will now be described in more detail with reference to exemplifying embodiments thereof and with reference to the accompanying drawings, in which

- Figure 1 illustrates schematically and in axial section a first embodiment of the inventive arrangement; and
- Figure 2 is an axial section view of an inner tube, an outer tuber and a filling tube or liner of a second embodiment of the inventive arrangement.

In the description and Claims, the word gas is used to identify both individual gases and gas mixtures, for example explosive mixtures of combustible gas and an oxidizing gas.

Shown in Figure 1 is an outer tube or pipe 1 in which an inner tube or lining 2 is placed. The tubes are closed at both ends by end covers 3,

3'. A mixture of combustible gas 5, e.g. hydrogen gas, acetylene, hydrocarbons such as gasol, town gas, gasolene, etc., and an oxidizing gas 6, such as oxygen gas or air is introduced through one of said end covers.

The explosive gas is intended to be exploded by ignition with, e.g., an electric spark or a pyrotechnic ignition cartridge. The illustrated embodiment comprises an electrical ignition system, including spark plug 7, cable connection 8, and a high voltage unit 9.

The reference 10 identifies a non-return valve which prevents the explosion from propagating to the gas delivery system upon ignition.

The pressure generated within the inner tube by explosion of the gas is determined by the composition, pressure and temperature of the gas prior to the explosion. Gas pressure can also be affected by mixing-in other gases, such as nitrogen, carbon dioxide, etc.

Expansion of the inner tube is facilitated when the gap 1' defined between opposing surfaces of the inner and outer tubes is evacuated of air during the tube joining process, for instance prior to the explosion. This can be achieved, for instance, with the aid of a hole 1" through the outer tube 1 (Figure 1) which places the gap 1' in communication with the ambient surroundings of the outer tube, the gap being evacuated, for instance, through a nipple 1''' and a vacuum pump not shown. In order to obtain a controlled and reproducible expansion, gas quantities and gas pressures are preferably controlled by automatics 11, comprised of solenoid valves and time-function electronics for instance. According to one preferred embodiment, the energy content of the explosive gas is intended to be adapted for plastic deformation of the inner tube and solely for elastic deformation of the outer tube.

The air is evacuated through a line 12 fitted with a valve, prior to introducing the explosive gas. Alternatively, the line is left open during the initial inflow of gas and is closed when the gas pressure increases. This method is used preferably when the air is used as an oxidizing gas.

When the explosion has taken place, the pressure is relieved through a

pressure relief line 13, whereafter the end covers are removed.

In the case of continuous production, the end cover through which the gas is introduced is preferably fixedly mounted and the opposite end cover is capable of being moved axially by means of hydraulic devices (not shown) for example.

In the case of large tube dimensions, the inner tube will accommodate much more gas than that required for its expansion. In this case, the gas may be given a low initial pressure or may be admixed with an inert gas or air. Another alternative is to reduce the volume of the inner pipe, by placing therein an homogenous or hollow rod, as indicated in Figure 2. In the Figure 2 embodiment, 1 identifies the outer tube, 2 identifies the inner tube and 14 identifies a rod or a thick-walled tube. The end covers with attachments shown in Figure 1 are not shown in Figure 2. The gas is introduced into the inner tube and caused to explode in the space 15 between the bar or tube 14 and the inner tube.

The inventive method and the method of operation of the inventive arrangement will be understood in all essentials from the aforegoing.

It will also have been understood that the invention provides a method of joining mechanically an inner tube to an outer tube in a far quicker and much simpler manner than can be achieved with known techniques.

The invention has been described in the aforegoing with reference to different embodiments. It will be understood, however, that other embodiments and minor modifications are conceivable within the scope of the inventive concept.

For example, the gap 1' can be evacuated through one of the end covers 3, 3', as indicated by the broken arrow 3" in Figure 1.

The invention shall not therefore be considered limited to the aforedescribed and illustrated embodiments, since modifications can be made within the scope of the following Claims.

Claims

1. A method for joining mechanically an inner tube to an outer tube by radial expansion of at least the inner tube, with the aid of an internal overpressure, characterized by filling the inner tube with an explosive gas and by igniting the gas and causing the same to explode.

2. A method according to Claim 1, characterized by adjusting the energy content of the explosive gas upon ignition and explosion, such that the inner tube will be deformed plastically and the outer tube will only be deformed elastically.

3. A method according to Claim 1 or 2, characterized by evacuating air from the inner tube prior to introducing the explosive gas.

4. A method according to Claim 1 or 2, characterized by evacuating air from the inner tube with the aid of a gas intended to form an explosive gas.

5. A method according to Claim 1, 2, 3 or 4, characterized by decreasing the specific energy content of the explosive gas by using a relatively low initial pressure and/or by diluting the gas with an inert gas, such as nitrogen or carbon dioxide.

6. A method according to Claim 1, 2, 3, 4 or 5, characterized by reducing the available gas-filling volume of the inner tube by placing a body in the inner tube.

7. A method according to Claim 1, 2, 3, 4, 5 or 6, characterized by evacuating the gap defined between the inner tube and the outer tube of air during the tube joining process.

8. A method according to any one of the preceding Claims, characterized by placing the tubes between two covers which sealingly connect the tubes; providing an explosive-gas delivery

line at one end cover which is preferably fixedly arranged; providing evacuation outlets at the other end cover, which is preferably capable of being moved axially by means of hydraulic devices.

9. A method according to any one of the preceding Claims, c h a r - a c t e r i z e d in that the combustible part of the explosive gas is comprised of one of the gases hydrogen gases, acetylene or hydrocarbon gas, such as gasol, town gas or gasified petroleum products.

10. An arrangement for joining mechanically an inner tube to an outer tube by radial expansion of at least the inner tube with the aid of an internal overpressure, characterised by a device for introducing into the inner tube an explosive gas; and by a further device for igniting the explosive gas to explode the same.

11. An arrangement according to Claim 10, further comprising a device for adjusting the energy content of the explosive gas so that the inner tube is deformed plastically and so that the outer tube is deformed only elastically.

12. An arrangement according to Claim 10 or 11, further comprising an evacuating device for evacuating air from the inner tube prior to or in conjunction with introducing the explosive gas.

13. An arrangement according to Claim 10, 11 or 12, further comprising devices for delivering an inert gas to the inner tube so as to reduce the specific energy content of the explosive gas.

14. An arrangement according to Claim 10, 11, 12 or 13, further comprising a body for insertion into the inner tube so as to reduce the available gas-filling volume in said inner tube.

15. An arrangement according to Claim 10, 11, 12, 13 or 14, further comprising a device for evacuating the gap defined between the inner tube and the outer tube during the tube joining process.

16. An arrangement according to Claim 10, 11, 12, 13, 14 or 15, further comprising two end covers between which the tubes are sealingly disposed; in that an explosive gas delivery line is provided in a first of said end covers said end cover preferably being fixedly mounted; and in that evacuation outlets are provided in the other of said end covers, said end cover preferably being moveable axially by means of hydraulic devices for instance.

17. A method for joining an inner tube to an outer tube by radial expansion substantially as herein described and illustrated with reference to the accompanying drawings.

18. An arrangement for joining mechanically an inner tube to an outer tube by radial expansion substantially as herein described and illustrated with reference to the accompanying drawings.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number: 9211024.6

Relevant Technical fields

(i) UK Cl (Edition K) F2P (PC20,PM1,PTBL,PR): B34

(ii) Int Cl (Edition 5) B21D 26/08

Search Examiner: B J PROCTOR

Databases (see over)

(i) UK Patent Office

(ii)

Date of Search: 28.07.92

Documents considered relevant following a search in respect of claims 1 AND 10 AT LEAST

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	GB 2173276 A (CASTLE LEAD WORKS) - eg Figure 2	1,2,10,16

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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&: Member of the same patent family, corresponding document.

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